Visual Examination

All repointing work on historic masonry buildings should be preceded by an analysis of the mortar and by an examination of the bricks and the techniques used in the original construction of the wall. For most projects, a simple visual analysis of the historic mortar is sufficient to allow an appropriate match for the new mortar. The exact physical and chemical properties of the historic mortar are not of major significance as long as the new mortar:

- matches the historic mortar in color, texture, and detailing;
- is softer (measured in compressive strength) than the brick;
- is as soft, or softer (measured in compressive strength) than the historic mortar.

A simple method of analyzing the historic mortar to aid in developing an appropriate repointing mortar for many restoration jobs and most rehabilitation work follows[1]:

1) Remove three or four unweathered samples of the mortar to be matched from several locations on the building (set the largest sample aside—this will be used later for comparison with the repointing mortar). It is important to recognize that many historic buildings have been repointed a number of times and that on any given wall surface there may be a variety of mortars. Therefore, it is important to remove as many samples as are representative to obtain a "mean" mortar sample.
2) Break the remaining samples apart with a wooden mallet until they are separated into their constituent parts. There should be a good handful of the material.
3) Carefully blow away the powdery material (the lime or cement matrix which bound the mortar together).
4) With a low power (10 power) magnifying glass, examine the remaining sand and other materials such as oyster shells.
5) Note and record the wide range of color as well as the varying sizes of the individual grains of sand or shell.

Historic sand colors may range from white to grey to yellow within a given mortar sample. Furthermore, the varying sizes of the grains of sand or other materials such as shell play an important role in the texture of the repointing mortar. Historic sand was not screened or graded by size as it is today. Therefore, when specifying sand for repointing mortar, consideration may need to be given to obtaining sand from several sources and then combining them in order to approximate the range of sand colors and grain sizes in the historic mortar sample. The role of the sand in the overall appearance of the replacement mortar should not be underestimated!

Pointing styles and the methods of producing them should be examined (figure 2). It is important to look at both the horizontal and the vertical joints to determine the order in which they were tooled and whether they were the same style. Some late-19th- and 20th-century buildings, for example, have horizontal joints that were tooled while the vertical joints were finished flush and stained to match the bricks, thus creating the illusion of horizontal bands. It is significant to note that pointing styles often differed from one facade to another. Front walls often received greater attention to mortar detailing than side and rear walls.

Bricks should also be examined so that any replacement will match the historic brick. Within a wall there may be a surprising range of colors, textures, and sizes, particularly with hand-made brick. Replacement should match the full range of the historic brick rather than a single brick. Although many bricks can be matched from existing stock, they must often be custom-ordered, a lengthy process that can seriously affect the project budget and schedule. Here, there should be a note of caution! The use of recycled brick from demolished buildings for replacement brick often results in an excellent color and texture match; however, it is important to remember that historic brick was manufactured in varying grades, ranging from high-fired exterior brick to low-fired interior "bat" or "clinker" brick. This low-fired brick was never intended to be exposed to the weather, and, when used for replacement brick on an exterior wall, will deteriorate at a rapid rate, often needing replacement within a year or two. Great care, therefore, should be taken in choosing the proper type of recycled brick.

Properties of Mortar

In general, mortars for repointing should be softer (measured in compressive strength) than the masonry units and no harder than the historic mortar. This is necessary to prevent damage to the masonry units. It is a common error to assume that hardness or high strength is a measure of durability. Stresses within a wall caused by expansion, contraction, moisture migration, or settlement must be accommodated in some manner; in a masonry wall, these stresses should be relieved by the mortar rather than by the bricks. A mortar that is stronger or harder than the bricks will not "give," thus causing the stresses to be relieved through the bricks—resulting in cracking and spalling (figure 3). Stresses can also break the bond between the mortar and the brick, permitting water to penetrate the resulting hairline cracks.

Constituents of Mortar

Sand: Sand is the largest constituent of mortar and the material that gives mortar its characteristic color and texture. When viewed under a magnifying glass or low-power binocular microscope, particles of sand generally have either rounded edges, such as found in beach or river sand, or sharp, angular edges, found in crushed or manufactured sand. For repointing mortar, rounded or natural sand is preferred for two reasons. First, it is usually similar to the sand in the historic mortar, thus providing a better visual match. Second, it has better "working" qualities or plasticity and can thus be forced into the joint more easily, forming a good contact with the historic mortar and the surface of the bricks. Although manufactured sand is frequently the only type readily available, it is worth the search to locate a sufficient quantity of rounded or natural salt-free sand for repointing.

[1] Two detailed methods for performing a mortar analysis are presented by E. Blaine Cliver in "Tests for the Analysis of Mortar Samples" in the *Bulletin* of the Association for Preservation Technology, vol. 6 (no. 1, 1974); and Morgan W. Phillips in "Brief Notes on the Subjects of Analyzing Paints and Mortar and the Recording of Moulding Profiles: The Trouble with Paint and Mortar Analysis" in the *Bulletin* of the Association for Preservation Technology, vol. 10 (no. 2, 1978).